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भाग 1 परिभाषा, सामान्य अपेक्षा तथा परीक्षण

Indian Standard

SPECIFICATION FOR ELECTRONIC EQUIPMENT/SYSTEMS FOR USE IN COAL AND METALLIFERROUS MINES

PART 1 DEFINITIONS, GENERAL REQUIREMENTS AND TESTS

UDC 622·489 : 624 : 38/39 : 622·333

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

June 1991 Price Group 5

Mining Electronics Sectional Committee, LTD 32

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards after the draft finalized by the Mining Electronics Sectional Committee had been approved by the Electronics and Telecommunication Division Council.

The object of this standard is to lay down requirements for communication, safety and industrial electronic equipment/systems for use in coal and metalliferrous mines. The limits of performance have been so chosen as to ensure sufficient freedom in design. Annexures A, B and C list the commonly used electronic equipment/systems pertaining to communication, safety and industrial electronics respectively.

While preparing this standard, the statutory regulations in this country have been kept in mind. However, if there is conflict between statutory regulations in force in any area and the Standard, the provisons of the former will prevail.

This standard (Part 1) is the first of a series of standards on 'Specification for electronic equipment/ systems for use in coal and metalliferrous mines'. It is envisaged that the detailed requirements for all the equipment/systems listed in Annexures A, B and C shall be covered in the subsequent parts.

While referring to any particular electronic equipment/system in coal and metalliferrous mines, this particular standard (Part 1) shall be read in conjunction with the relevant Indian Standard which deals exclusively with that equipment/system.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

SPECIFICATION FOR ELECTRONIC EQUIPMENT/SYSTEMS FOR USE IN COAL AND METALLIFERROUS MINES

PART 1 DEFINITIONS, GENERAL REQUIREMENTS AND TESTS

1 SCOPE

1.1 This standard covers the general conditions, requirements and tests applicable to all communication, safety and industrial electronic equipment/systems for use in coal and metalliferrous mines.

1.2 Other requirements and tests specific to the individual electronic equipment/system have been included in the relevant parts of this standard.

2 REFERENCES

2.1 The Indian Standards listed in Annex E are necessary adjuncts to this standard.

3 TERMINOLOGY

3.1 For the purpose of this standard, the terms and definitions covered in IS 5780 : 1980 and IS 2148 : 1981 shall apply in addition to the ones given under.

3.1.1 *Acceptance Test*

The whole of the tests carried out in presence of the customer's representative in order to check the quality of the units of one consignment.

3.1.2 *Automatic Telephone Exchange*

An exchange which works automatically to provide telephonic communication between subscribers.

3.1.3 *Beam Expander*

The unit used to make the beam symmetrical over the entire range.

3.1.4 *Cage Communication*

The two-way communication between the banksman, onsetter, engine driver or any other personnel on one side and moving cage crew on the other side through an induction loop.

3.1.5 *Coal Ash*

The amount of ash contained in coal.

3.1.6 *Coal Tub Counter*

An instrument which can count the number of coal tubs either at rest or in motion and can indicate the same.

3.1.7 *Coal Tub Weigher*

An instrument which can measure the weight of each coal tub either at rest or in motion and can indicate the same.

3.1.8 *Coking Coal*

Coal that gives metallurgical coke either of its own or in admixture with some other coal.

3.1.9 *Concentration*

The mass, volume or number of moles of the combustion gas or vapour divided by the volume of the mixture with air.

3.1.10 *Continuous Duty Apparatus*

Apparatus which are continuously powered but may have continuous or intermittent operation.

3.1.11 *Cross Talk*

Electrical disturbances in a communication channel as a result of coupling with other communication channels.

3.1.12 *Detector*

A device which senses presence or absence of a specific parameter or a number of specific parameters.

3.1.13 *Detector Head (Gas)*

A device which senses presence or absence of a gas or number of specified gases.

3.1.14 *Display Unit*

A device which accepts processed signal and indicates a calibrated/scaled value in a visual format proportional to the input signal.

3.1.15 *Dynamic Error*

The difference between static and dynamic measurements, that is, the difference between the measurements carried out when the coal tubs are at rest and in motion.

3.1.16 *Electrical Apparatus for Explosive Atmospheres*

Electrical apparatus constructed in such a way that, under specified conditions, it will not cause an explosion of the atmosphere surrounding this electrical apparatus.

NOTE — The following terms are synonymous to the above terms:

a) Explosion protected electrical apparatus, and
b) Hazardous location equipment.

3.1.17 *Electrical Transducer*

A transducer which converts any kind of energy to electrical energy or vice versa.

3.1.18 *Environmental Monitor*

A device which detects various environmental parameters of a mine with the help of transducers and displays the instantaneous values of parameters.

3.1.19 *Environmental Telemonitor*

A device which detects and measures various environmental parameters with the help of transducers and transmits and displays the measured environmental parameters over a distance.

3.1.20 *Explosive Atmosphere*

Mixture with air, under atmospheric conditions, of flammable substances in the form of gas, vapour mist, dust or fibres in which after ignition, combustion spreads throughout the unconsumed mixture.

3.1.21 *Fixed Apparatus*

An apparatus which is intended to have all parts permanently installed.

3.1.22 *Gassy Mine*

Mine in which firedamp may normally and naturally occur.

3.1.23 *Goaf*

Any part of workings below ground wherefrom a pillar or part thereof, or in case of long wall workings, coal has been extracted, but which is not a working place.

3.1.24 *Goaf Temperature Monitor*

A temperature monitor which has several sensors located inside the goaf, each sensor being selectable for local display and which has a local alarm facility.

3.1.25 *Ground Fault*

The fault with the power line under which it touches the earth/ground point.

3.1.26 *Hazarduous Area*

An area in which an explosive gas atmosphere is or may be expected to be present in quantities such as to require special precaution for the construction, installation and use of electrical apparatus.

3.1.27 *Helium-Neon Plasma Tube*

Source of emission of low power visible LASER beam having wavelength of 0·632 8 micrometers.

3.1.28 *Image Frequency*

The sum of the signal frequency and twice the intermediate frequency.

3.1.29 *Image Rejection*

The ratio of the gain at signal frequency to the gain at image frequency.

3.1.30 *Insulation Resistance*

The resistance under specified conditions between two conductors or system of conductors normally separated by an insulating material.

3.1.31 *Intensity Reducing/Adjusting Filter*

The filter used to bring the intensity of radiation of the LASER beam within the stipulated range as specified by DGMS.

3.1.32 *Interlocking Facilities*

The facilities by virtue of which a system does not allow itself to start unless certain conditions are met.

3.1.33 *Intermediate Frequency*

The difference of the local oscillator frequency and the signal frequency.

3.1.34 *Leaky Feeder*

A coaxial cable with controlled radiofrequency leakage characteristics.

3.1.35 *Line Repeater*

An amplifier used for compensating the attenuation of the transmitting cable.

3.1.36 *Lower Explosive Limit (LEL)*

The concentration of flammable gas, vapour or mist in air below which an explosive gas atmosphere will not be formed.

3.1.37 *Maximum Surface Temperature*

The highest temperature attained in service under the most adverse conditions (but within the tolerances) by any part or any surface of an electrical apparatus, beyond which ignition of the surrounding atmosphere will occur.

NOTE — The most adverse conditions include recognized overloads and any fault condition recognized in the specific standard for the type of protection concerned.

3.1.38 *Middlings*

That part of the product of a washery, concentration or preparation plant which is neither clean coal nor mineral nor reject (tailings). It consists of fragments of coal and shale or mineral and gangue.

3.1.39 *Mine Winder*

A mechanism or a system responsible for the controlled movement of the cage or the skip along the shaft for raising or lowering of men, material and coal.

3.1.40 *Monitor*

A device which detects a specified parameter or a number of specified parameters with the help of a suitable transducer(s) and displays the instantaneous value(s) of the parameter(s).

3.1.41 *Paging*

A means of locating personnel.

3.1.42 *Parallel Mode of Communication*

Communication between a number of subscribers at a time.

3.1.43 *Party Line Communication*

Communication between two selective parties among different subscribers.

3.1.44 *Portable Apparatus*

A spot reading or continuously sensing apparatus designed to be readily carried from place to place and to be used whilst being carried. Portable apparatus is battery powered and includes but is not limited to:

a) hand held small apparatus less than 1 kg suitable for single handed operation;

b) personal monitors, similar in size and mass to the hand-held apparatus, which are continuously operating (but not necessarily continuously sensing) whilst attached to the user; and

c) larger apparatus upto 5 kg. that can be operated by the user whilst suspended by hand, by a shoulder strap or by a carrying harness. It may or may not have a hand directed probe.

Alternatively : Apparatus designed to be moved while it is in use.

3.1.45 *Power Station Coal*

Coal which is required as a primary source of energy for power station.

3.1.46 *Power Supply Unit*

A device which supplies power to different units of electrical and electronic circuits.

3.1.47 *Processing Unit*

A device which accepts electrical signals from detector head and conditions the same.

3.1.48 *Radiating Cable*

A cable used to transmit signals in the form of electromagnetic waves.

3.1.49 *Radio Paging*

Paging by means of radio waves.

3.1.50 *Receiver*

A device for acceptance, detection and reproduction of the required information in a desired form.

3.1.51 *Ropeway*

An electrically driven system used for conveying materials in pots or buckets suspended on steel ropes.

3.1.52 *Routine Test*

A test which each individual device is subjected during or after manufacture to ascertain whether it complies with certain criteria.

3.1.53 *Safety*

Safety means freedom from those conditions that may cause death, injury or occupational illness to human beings and hazards to equipment.

3.1.54 *Safety Equipment*

The equipment which is used to indicate parameters/factors affecting the safety or personnel, equipment and environment.

3.1.55 *Shaft*

A way of opening, leading from the surface to working below ground or from one part of the working below ground to another, in which a cage or other means of conveyance can travel freely suspended with or without use of guides.

3.1.56 *Sound Powered Speech Circuit*

A circuit in which the transmitting element generates speech current by direct conversion of voice energy, thus dispensing with the need for usual microphone and associated battery.

3.1.57 *Spot Reading Apparatus*

An apparatus intended to be used for short periods of time as required.

3.1.58 *Telecontrol*

The control of operational equipment at a distance using the transmission of information by telecommunication techniques.

NOTE — Telecontrol may comprise any combination of command, alarm, indication, metering, protection and tripping facilities without any use of speech messages.

3.1.59 *Telemonitor*

A device which senses, transmits and displays the measured parameters over a distance.

3.1.60 *Telemonitoring*

The supervision of the status of operational equipment and environment at a distance using telecommunication techniques.

3.1.61 *Transducer*

A device designed to receive energy from one system and supply energy, generally of a different kind, to another in such a manner that the desired characteristics of the input energy appear at the output.

3.1.62 *Transmitter*

A device for production, modulation and sending of energy of any form for the purpose of communication.

3.1.63 *Transportable Apparatus*

An apparatus not intended to be portable, but which can readily be moved from one place to another.

3.1.64 *Type Test*

A test of one or more devices made to a certain design to show that the design meets certain specifications.

3.1.65 *Upper Explosive Limit* (*UEL*)

The concentration of flammable gas, vapour or mist in air above which an explosive gas atmosphere will not be formed.

4 CLASSIFICATION OF COAL MINES

4.1 For the purpose of this standard, the classification of coal mines as specified in IS 9559 : 1980 shall apply.

5 GENERAL REQUIREMENTS

5.1 All communication equipment/systems and the local monitors of the safety equipment/systems shall have standby rechargeable batteries, the capacity of which shall be specified by the purchaser.

5.2 For communication equipment, maximum acoustical output level at a distance of one metre along the central axis of the speaker cone for speaker, and at adjacent position to the capsule for the receiver shall not exceed 124 dB(A). The minimum acoustical level shall be specified by the purchaser.

5.3 Each electronic equipment/system shall be protected against ingress of solid foreign bodies or liquid particles. All safety equipment shall have IP55 as the minimum degree of protection. However, for non-safety equipment, the minimum degree of protection for the part(s) which will be used in hazardous area shall be IP54 whereas for the part(s) which will be used in non-hazardous area, the minimum degree of protection shall be IP20. However, use of each electronic equipment in hazardous or non-hazardous area shall be specified by the user.

5.4 Interlocking devices used to maintain a type of protection shall be so constructed that their effectiveness cannot readily be defeated by the use of normally available tools.

5.5 Material used for cementing, except gasket, shall be chemically stable, inert and resistant to water, oil and solvents.

5.6 Enclosure of plastic material shall also be chemically stable and resistant to water, oil and solvents.

5.7 The voltage employed in underground transmission, distribution and use may be as follows:

a) Transmission of power from surface to pit bottom; 11 kV, 6·6 kV, 3·3 kV, 550V and 415 V.

b) Distribution of power underground; 6·6 kV, 3·3 kV, 550 V, 415V.

c) Utilization of power underground:
   1) Fixed and transportable equipment may be 3·3 kV, 550 V, 415 V and/or 110 V;
   2) Portable equipment — 550 V, 415 V and/or 110V;
   3) Hand-held portable equipment — 110 V;
   4) Intrinsically safe dc power supply — 110 V ac.

d) *Underground Lighting* — 110 V between phases with mid-point in case of single phase and neutral point in case of 3 phase system, earthed.

e) *Signalling* — The voltage for signalling circuits may be:
   1) Intrinsically safe systems — up to 15 V ac or 24 V dc.
   2) Non-intrinsically safe systems — up to 24 V ac or dc.

However, the voltage in any one circuit shall not exceed 30 V ac or dc.

f) *Telecommunication* — Only approved intrinsically safe telecommunication equipment shall be used.

g) *Environmental Monitoring System* — Only approved type of equipment shall be used, taking into account its safety aspects.

Power supply — ac operation for automatic change-over to battery operation in case of failure of ac supply and type protected. Available power underground in Indian mines is (i) 525 V 3 phase, 50 Hz; and (ii) Single phase 110 V, 50 Hz ac supply.

NOTE — In case of opencast and metalliferrous mines, standard industrial voltages as per Indian Electricity Rules may be used.

6 SAFETY REQUIREMENTS

6.1 The part(s) of each electronic equipment which will be used in hazardous area, shall meet the requirements of intrinsic safety as per IS 5780 : 1980 or flameproofness of enclosure as per IS 2148 : 1981 or a combination of both.

6.2 Any other type of protection except oil immersed protection may also be used if approved by the competent authority (DGMS).

6.3 For protection of personnel using the electronic equipment against possible hazards, each equipment, wherever required, shall have adequate operational safety as agreed between the purchaser and the manufacturer.

6.4 The electrical safety tests for insulation resistance, leakage current and dielectric strength shall be carried out as specified in IS 616 : 1986 [**9.1.1** for leakage current and **10.3** (Table IV) for insulation resistance and dielectric strength].

7 FUNCTIONAL REQUIREMENTS

7.1 Each electronic equipment shall meet the functional requirements as specified in the relevant specification.

8 MARKING

8.1 The individual building blocks of each electronic equipment shall be legibly and indelibly marked with the information as will be required necessary by the competent authority (DGMS).

8.2 The part of each electronic equipment which will be used in hazardous area, shall meet the requirements of either **10** of IS 5780 : 1980 or **23** of IS 2148 : 1981 or both.

8.3 The equipment may also be marked with the Standard Mark.

9 ENVIRONMENTAL REQUIREMENTS

9.1 The severity and requirements of the various environmental tests to be carried out on an equipment/system are specified in Table 1.

10 TESTS

10.1 Classification of Test

10.1.1 *Type Tests*

10.1.1.1 Tests specified in Table 2 shall constitute type tests and shall be carried out on one sample in the following sequence.

After each test (except Group 0), the sample shall be checked for conformity of functional requirements as specified in the relevant standard.

10.1.2 *Routine Tests*

10.1.2.1 The routine tests shall be carried out on each sample as specified in the relevant standard.

10.1.3 *Acceptance Tests*

10.1.3.1 The acceptance tests shall be carried as per relevant standard on the samples that have passed the routine tests.

10.1.3.2 Sample shall be selected and subjected to acceptance tests to ascertain the conformity of each lot to the requirements specified. A recommended sampling plan and acceptance criterion is given in Annex D.

11 GENERAL CONDITIONS FOR MEASUREMENTS

11.1 All measurements shall be carried out under ambient conditions as specified in IS 9000 (Part 1) : 1977.

Table 1 Environmental Requirements

Sl No.	Test	Reference	Severity	Requirements
1.	Vibration test	IS 9000 (Part 8) : 1981	10 to 55 Hz with amplitude of 0·35 mm for a total duration of 6 h (2 h in each of 3 principal axes)	The system shall comply with the functional requirements as specified in the relevant Indian Standard
2.	Shock test	IS 9000 (Part 7/Sec 1) : 1979	Three consecutive half sinusoidal shock pulses of 30 g peak acceleration and 18 msecs duration in each direction of 3 mutually perpendiuclar axes (that is, a total number of 18 shock pulses to be applied)	As above
3.	Bump test	IS 9000 (Part 7/Sec 2) : 1979	1 000 bumps at 20 g, 6 msecs half sinusoidal pulses along each axis	As above
4.	Drop and topple test	IS 9000 (Part 7/Sec 3) : 1979	Drop height of 25 mm	As above
5.	Dry heat test	IS 9000 (Part 7/Sec 3) : 1977	70°C for 25 hours under operating and storage conditions for parts of the system to be used in hazardous area, 55°C for 25 hours under operating condition and 70°C for 25 hours under storage condition for parts to be used in non-hazardous area. Recovery period shall be one hour	As above
6.	Damp heat (cyclic) test	IS 9000 (Part 5/Sec 1) : 1981	2 cycles of 16 + 8 h each at 40°C and 98 percent RH. Recovery period shall be one hour	As above
7.	Cold test	IS 9000 (Part 2/Sec 3) : 1977	As agreed between purchaser and manufacturer within the provisions of relevant Indian Standard	As above
8.	Mould growth test	IS 9000 (Part 10) : 1979	As above	As above
9.	Endurance test	—	As specified in the relevant Indian Standard	As above

Table 2 Schedule of Type Tests

Group	Test	Clause
0	General requirements	5
	Safety requirements	6
	Functional requirements	7
	Marking requirements	8
1	Cold test (if applicable)	9.1 (Table 1, Sl No. 7)
2	Mould growth test (if applicable)	9.1 (Table 1, Sl No. 8)
3	Endurance test	9.1 (Table 1, Sl No. 9)
4	Vibration test	9.1 (Table 1, Sl No. 1)
	Shock test	9.1 (Table 1, Sl No. 2)
	Bump test	9.1 (Table 1, Sl No. 3)
	Drop and topple test	9.1 (Table 1, Sl No. 4)
5	Damp heat (cyclic) test	9.1 (Table 1, Sl No. 6)
6	Dry heat test	9.1 (Table 1, Sl No. 5)

ANNEX A

(*Foreword*)

LIST OF COMMUNICATION EQUIPMENT/SYSTEMS

1. Central Despatcher System
2. Automatic Telephone System
3. Sound Powered Magneto Telephone System
4. Battery Powered Amplifier Telephone System
5. Loud Hailing Telephone System
6. Cage Communication System
7. Leaky Feeder Communication System
8. Public Address System
9. Radio Paging System
10. VHF Sets for Open Cast Mines
11. Inductive Communication System
12. VLF Communication System for Trapped Miners
13. Shaft Signalling System

ANNEX B

(*Foreword*)

LIST OF SAFETY EQUIPMENT/SYSTEM

1. Mine Environmental Telemonitoring System
2. Portable or Fixed Gas Monitor
3. Goaf Temperature Monitor
4. Portable Air Velocity Monitor
5. Defectograph
6. Roof Fall Detector
7. Mine Winder Monitoring System
8. Run Away Coal Tub Alarm System

ANNEX C

(*Foreword*)

LIST OF INDUSTRIAL ELECTRONIC EQUIPMENT/SYSTEM

1. Insulation Resistance Tester
2. Status Monitoring System
3. Production Monitoring System
4. Integrated Sequential Conveyor Control and Machine Telemonitoring System
5. Coal Ash Monitoring System
6. Coal Tub Weighing and Counting System
7. Conveyor Belt Weighing System
8. LASER Alignment System
9. Aerial Ropeway Protection System
10. Auto Personnel Counter
11. Closed Circuit Television (CCTV) System
12. Cable Fault Locator
13. Automation of Coal Handling Plant or Washery
14. Automatic Truck Despatching System
15. Detection of Geological Discontinuities using RADAR Technique
16. Skip Automation & Monitoring System

ANNEX D

(*Clause* 10.1.3.2)

D-1 LOT

All electronic equipment/systems of the same model and type having the same design and manufactured by the same technique under essentially similar conditions of production.

D-1.1 Samples shall be picked up and tested to ascertain the conformity of each lot for acceptance tests.

D-2 SCALE OF SAMPLING

Electronic equipment/systems shall be taken at random as per IS 4905 : 1968 and according to 2, 3 of 4 Table **D.1**

D-3 NUMBERS OF TEST AND CRITERIA FOR CONFORMITY

D-3.1 Electronic equipment/systems shall be drawn at random from each lot according to 2, 3 and 4 of Table **D.1** and subjected to the acceptance test specified in **10.1.3.** If an electronic equipment/system fails in any of the acceptance tests, it shall be called a defective.

D-3.2 When single sampling plan has been specified, the lot shall be considered as conforming to the acceptance tests if no defectives are observed (*see* col 6). If the number of defectives is equal to or greater than 1 (*see* col 7), the lot shall be considered as not conforming to the acceptance test.

D-3.3 When double sampling plan has been specified, the lot shall be accepted if the number of defectives in the first sample of size as specified in col 4 is equal to or less than the number specified in col 6 and rejected if it is equal to or greater than the number specified in col 7. However, if the number of defectives is in between the numbers specified in col 6 and 7, a second sample of size as specified in col 4 shall be drawn and inspected. The lot shall be accepted if the total number of defectives in the cumulative sample of size as specified in col 5 is equal to or less than the number specified in col 6 and rejected if the number of defectives is equal to or more than the number specified in col 7.

Example :

Assuming a lot size of 1 000. The first sample size of 13 items has to be drawn at random and inspected. The lot shall be accepted if the number of defective items in the first sample is 0 and rejected if it is 3 or more. If the number of defective items is between 0 and 3 (that is, 1 or 2) a second sample of 13 items shall de drawn and inspected. The lot is accepted if the total number of defective items in the combined sample of 26 items is 3 or less and rejected if the number of defective items found is 4 or more.

Table D.1

[*See* Tables 1, 2 *and* 3 of IS 2500 (Part 1) : 1973]

Inspection Level : II

AQL for acceptance testing : 4 percent

Sl No.	**Lot Size**	**Sample**	**Sample Size**	**Cumulative Sample Size**	**Acceptance Number**	**Rejection Number**
(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	3 to 25	First	3	3	0	1
		Second	—			
2	26 to 100	First	5	5	0	1
		Second	—			
3	101 to 150	First	5	5	0	2
		Second	5	10	1	2
4	151 to 500	First	8	8	0	2
		Second	8	16	1	2
5	501 to 1 000	First	13	13	0	3
		Second	13	26	3	4

ANNEX E

(*Clause* 2.1)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
616 : 1986	Safety requirements for mains operated electronic and related apparatus for household and similar general use (*second revision*)
2148 : 1981	Flameproof enclosures for electrical apparatus (*second revision*)
2500 (Part 1) : 1973	Sampling inspection tables: Part 1 Inspection by attributes and by count of defects (*first revision*)
4905 : 1968	Methods for random sampling
5780 ; 1980	Intrinsically safe electrical apparatus and circuit (*first revision*)
9 000	Basic environmental testing procedures for electronic and electrical items
(Part 1) : 1977	General (*first revision*)
(Part 2/Sec 3) : 1977	Part 2 Cold test, Section 3 Cold test for non-heat dissipating items with gradual change of temperature
(Part 3/Sec 3) : 1977	Part 3 Dry heat test, Section 3 Dry heat test for non-heat dissipating items with sudden change of temperature
(Part 5/Sec 1) : 1981	Part 5 Damp heat (cyclic) test, Section 1 16 + 8 h cycle
(Part 7/Sec 1) : 1979	Part 7 Impact test, Section 1 Shock
(Part 7/Sec 2) : 1979	Part 7 Impact test, Section 2 Bump
(Part 7/Sec 3) : 1979	Part 7 Impact test, Section 3 Drop and topple
(Part 8) : 1981	Part 8 Vibration (sinusoidal) test
(Part 10) : 1979	Part 10 Mould growth test
9559 : 1980	Guide for selection of electrical and electronic equipment for coal mines

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